Hoist-Block

AIN SHAMS UNIVERSITY
FACULTY OF ENGINEERING

MACHINE CONSTRUCTION
2ND YEAR MECHANICAL
1979 - 1980

EXERCISE (I)

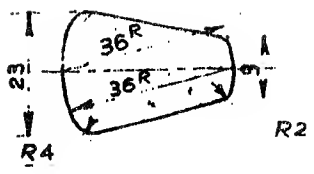
An Ordinary Single-Sheave Hoist-Block.

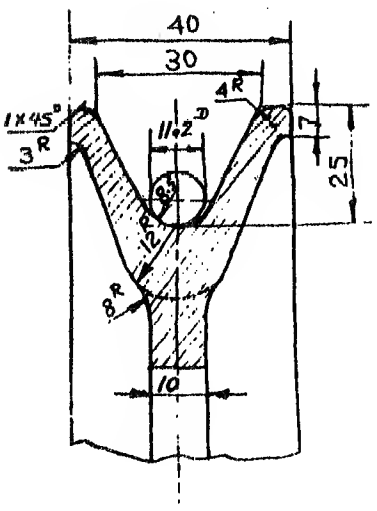
Guided by the given sketches of the hoist blocks, the 1.370 ton capacity standard hook and , the sheave rim ; it is required to make a complete constructional drawing for a 1.25 ton hoist block . The wire rope is selected to have the following specifications :

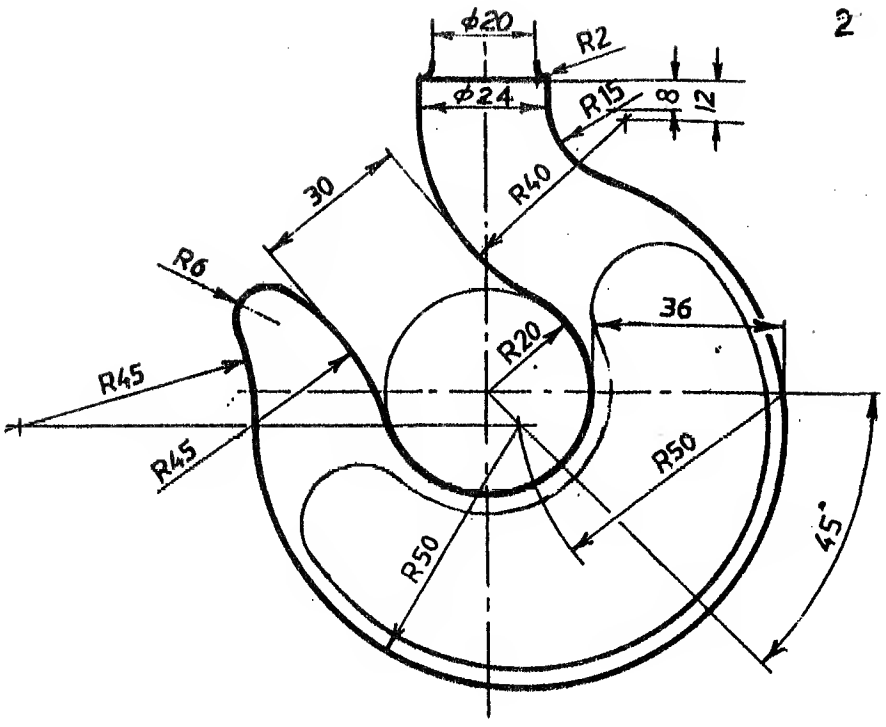
Nominal rope diameter	=	11.2	mm.
Wire diameter	=	0.71	mm.
U.T. strength of wire material	=	180	kg/mm^2

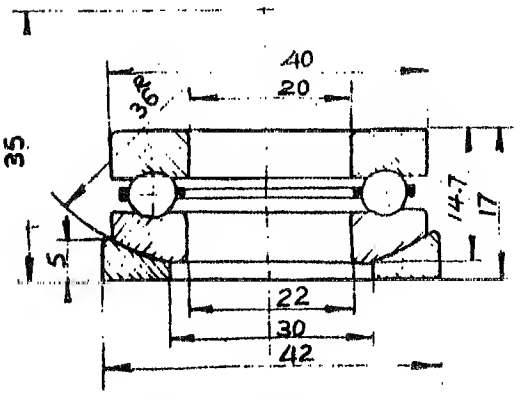
Cross laid type 6x19 = 114

The hoist is to be manually operated and a sheave diameter of 20 times the rope diameter is a minimum value .









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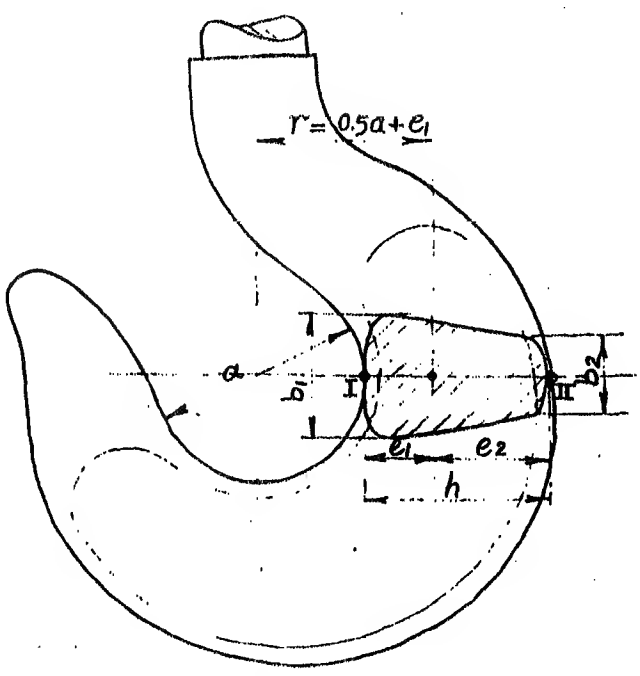
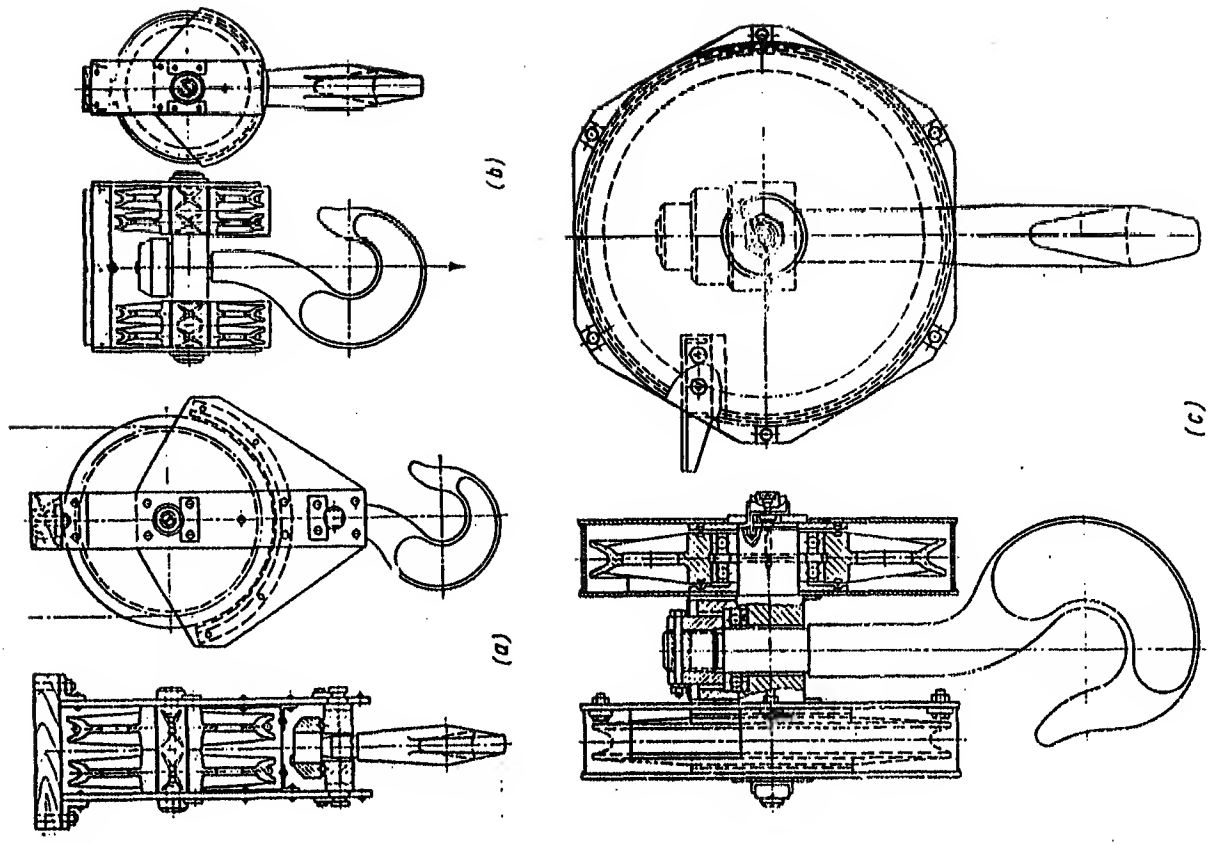


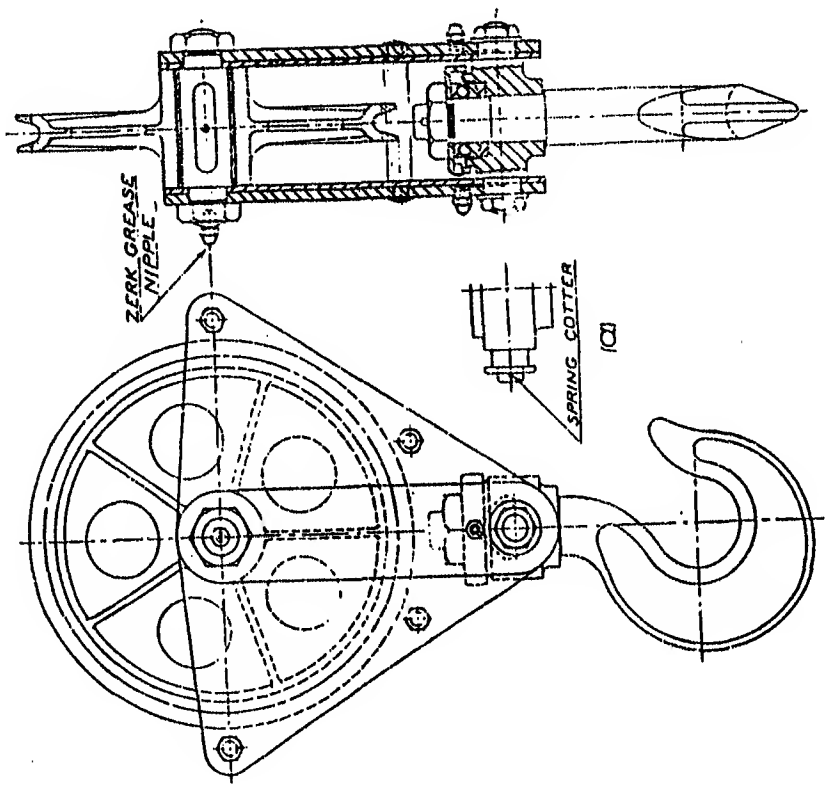
$$\sigma_I = \frac{Q}{A} \cdot \frac{1}{x} \cdot \frac{2e_1}{a} \leqslant \sigma_{all.}$$

$$\sigma_{II} = -\frac{Q}{A} \cdot \frac{1}{x} \cdot \frac{2e_2}{a+2h} \leqslant \sigma_{all.}$$

$$x = -1 + \frac{2r}{(b_1+b_2)h}\left[\left\{b_2 + \frac{b_1-b_2}{h}(e_2+r)\right\}\ln\frac{r+e_2}{r-e_1} - (b_1-b_2)\right]$$



Hook casings



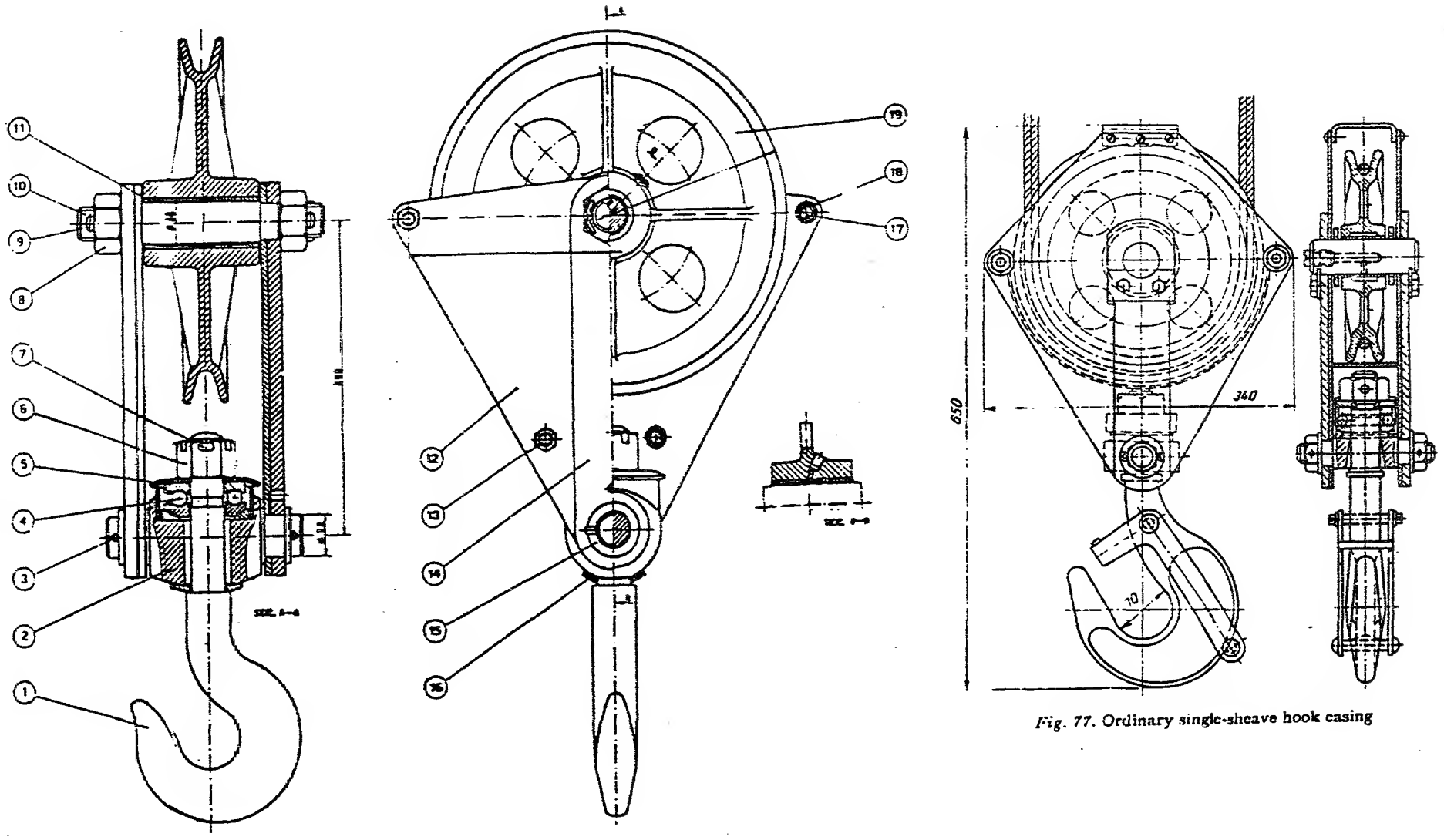


Fig. 77. Ordinary single-sheave hook casing

SINGLE-SHEAVE

HOOK CASING

Single sheave hoist block:

Guide-lines for calculations:

* Lifting capacity = 1.25 t = 12.5 kN
  Test load = 1.25 * 12.5 = 15.33 kN

Calculations & checks are carriedout for:

a- Sheave axle
b- Side strips
c- Hook supporting block.

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a - Sheave axle

From freehand sketch

Axle diam = d = 30 mm

Span (average) = 60 mm

a-1) Bending Stresses:

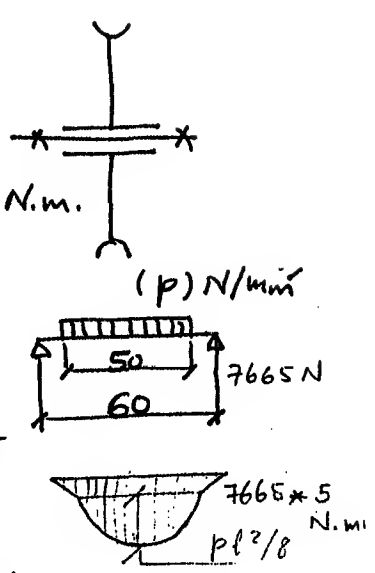
$$p = \frac{15330}{50} = 306{,}60 \ N/mm'$$

$$B.M._1 = \frac{p l^2}{8} = \frac{306.6 * 50^2}{8} = 95813 \ N.m.$$

$$B.M_2 = 7665 * 5 = 38325 \ N.m.$$

Max BM. = 134138 N.m.

$$\sigma_{bend\ test} = \frac{134138 * 32}{\pi (30)^3} = 50.6 \ N/mm^2$$



Min. yield stress ≥ margine of safety * $\sigma_{bend\ test}$

& margine of safety = 1.3 → 1.8

$$\therefore \sigma_y \geq 1.8 * 50.6 \geq 91 \ N/mm^2$$

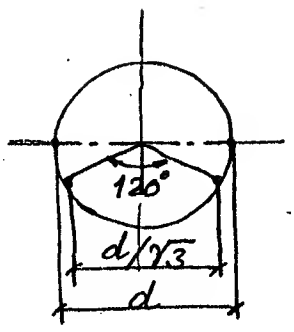
for: St. 37 , σ_y = 200 N/mm² → suitable for L, [, I
St. 42 , σ_y = 220 N/mm² → suitable for axles & rods

a-2) Check for bearing pressure;

For St/Br, allowable bearing pressure = 17 MPa

$$\text{Working bearing pressure} = \frac{12500\sqrt{3}}{30*50}$$

$$= 14.1 \ N/mm^2 < 17 \ MPa$$



a-3) Crushing in side plates;

$$\sigma_{cr.all} = \sigma_{yt}/1.5$$

$$\sigma_{cr.test} = \frac{1}{2} * \frac{15330}{12*30} = 21.3 \ N/mm^2$$

The axle suitable material is St 42

Note:

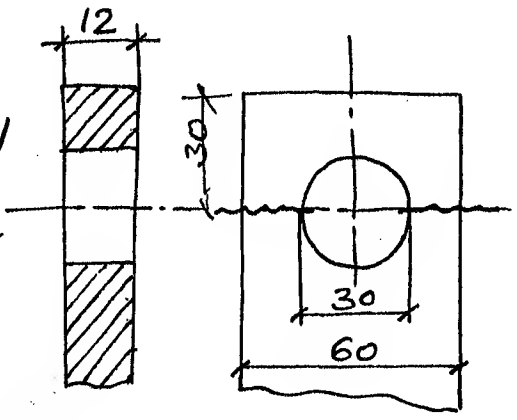
$$\sigma_{b\,working} = 50.6/1.25 = 40.5 \ N/mm^2$$

i.e. Working safty factor $= \frac{220}{40.5} = 5.43$

b- Side plate

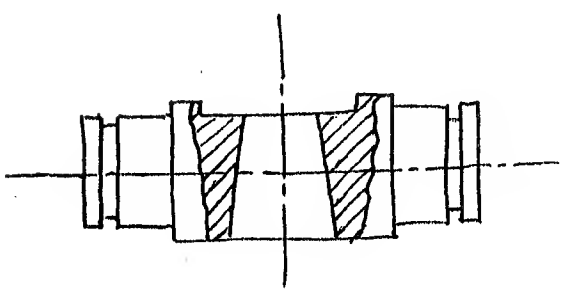
Test load/side $= \frac{15330}{2} = 7664 \ N$

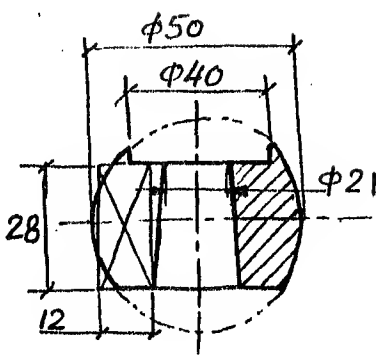
$$\sigma_t = \frac{7664}{(60-30)(12)} = 21.3 \ N/mm^2$$

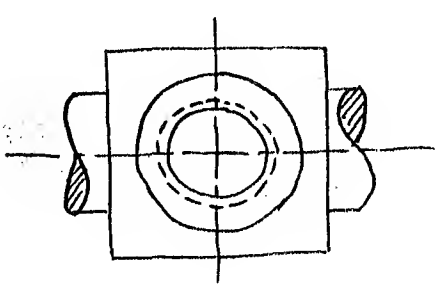


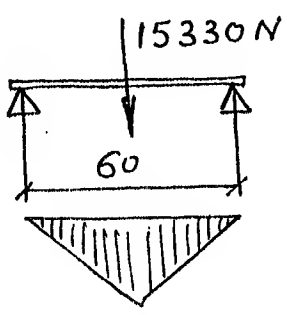
Suitable material is st. 37.

C - Hook Supporting block:









Bending moment = $\frac{Pl}{4}$
(test case)

$= \frac{15330 * 60}{4} = 230000 \ N\,mm$

$Z_b = bh^2/6 = 12(28)^2/6 = 1568 \ mm^3$

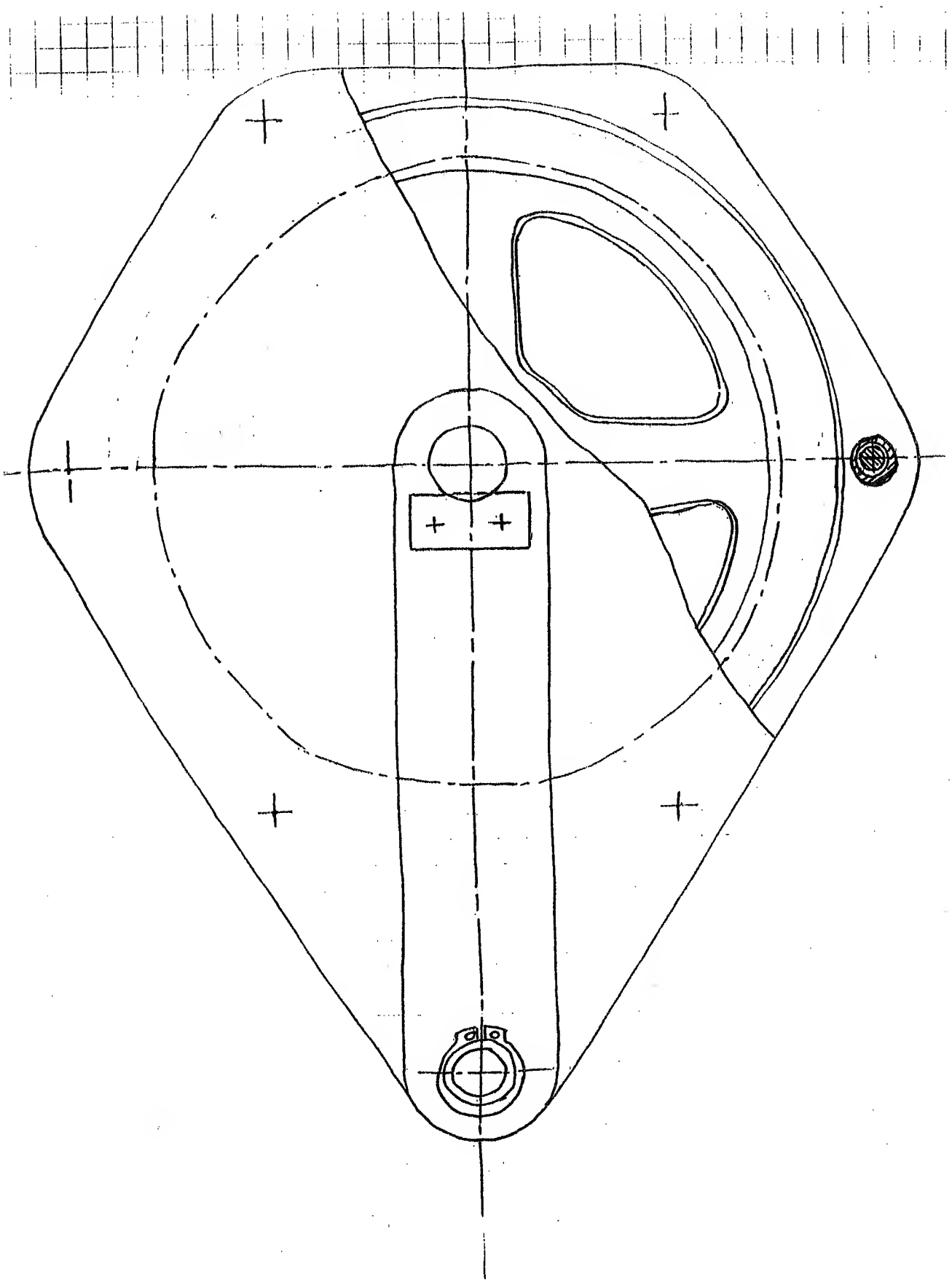
$\sigma_b = M/Z = \frac{230000}{1568} = 146.7 \ N/mm^2$

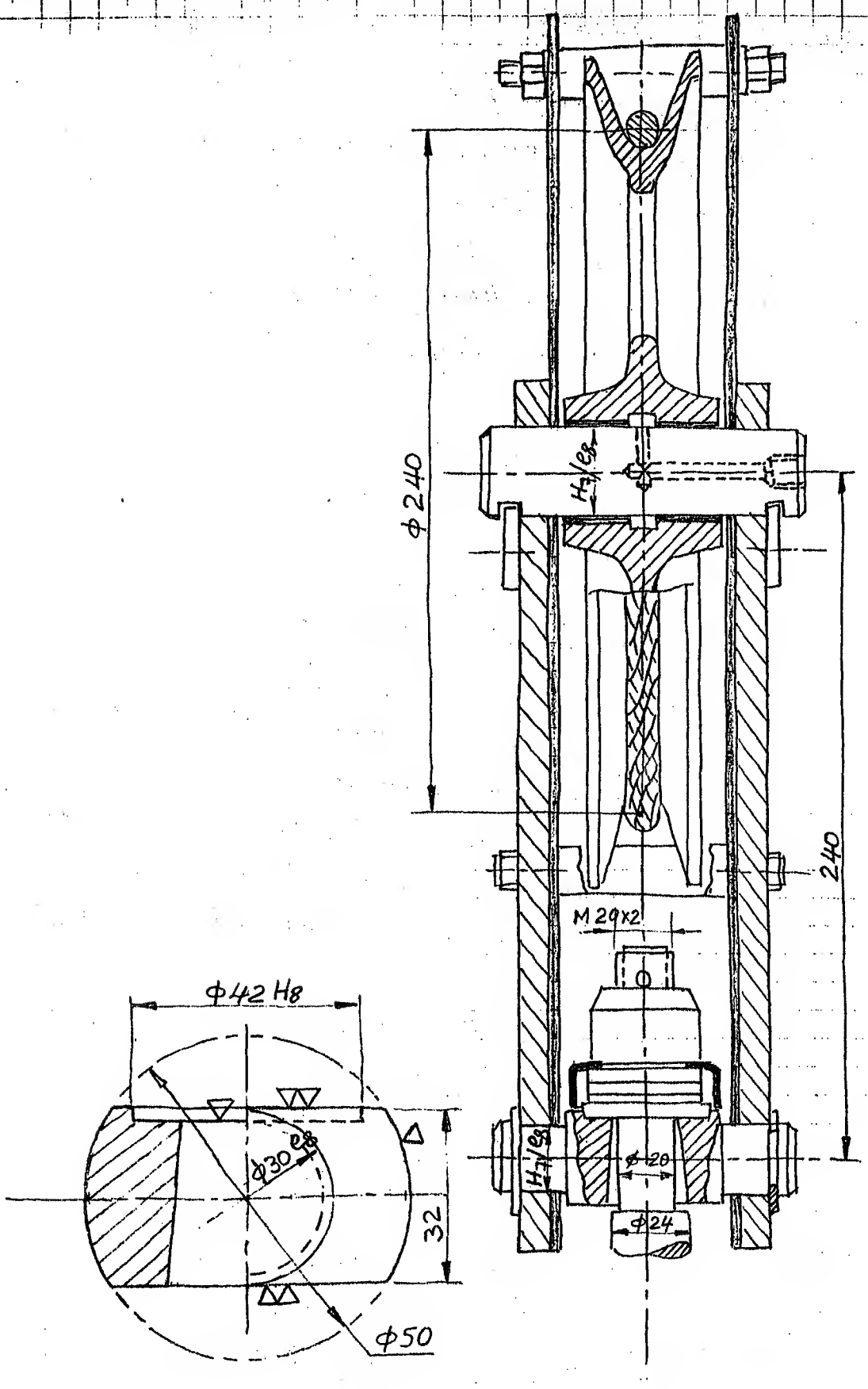
Material yield stress $\sigma_y \geq \sigma_b * 1.8$

$\geq 264 \ N/mm^2$

Suitable materials:

St. 60 ($\sigma_y = 300 \ N/mm^2$), St. C15 ($\sigma_y = 300 \ N/mm^2$), C 22 ($\sigma_y = 300 \ N/mm^2$)




ϕ240
H7/e8
240
M 29x2
ϕ42 H8
ϕ30 e8
32
ϕ50
H7/e8
ϕ 20
ϕ24